Campbell, Edwin
Zeppelins, the past and future

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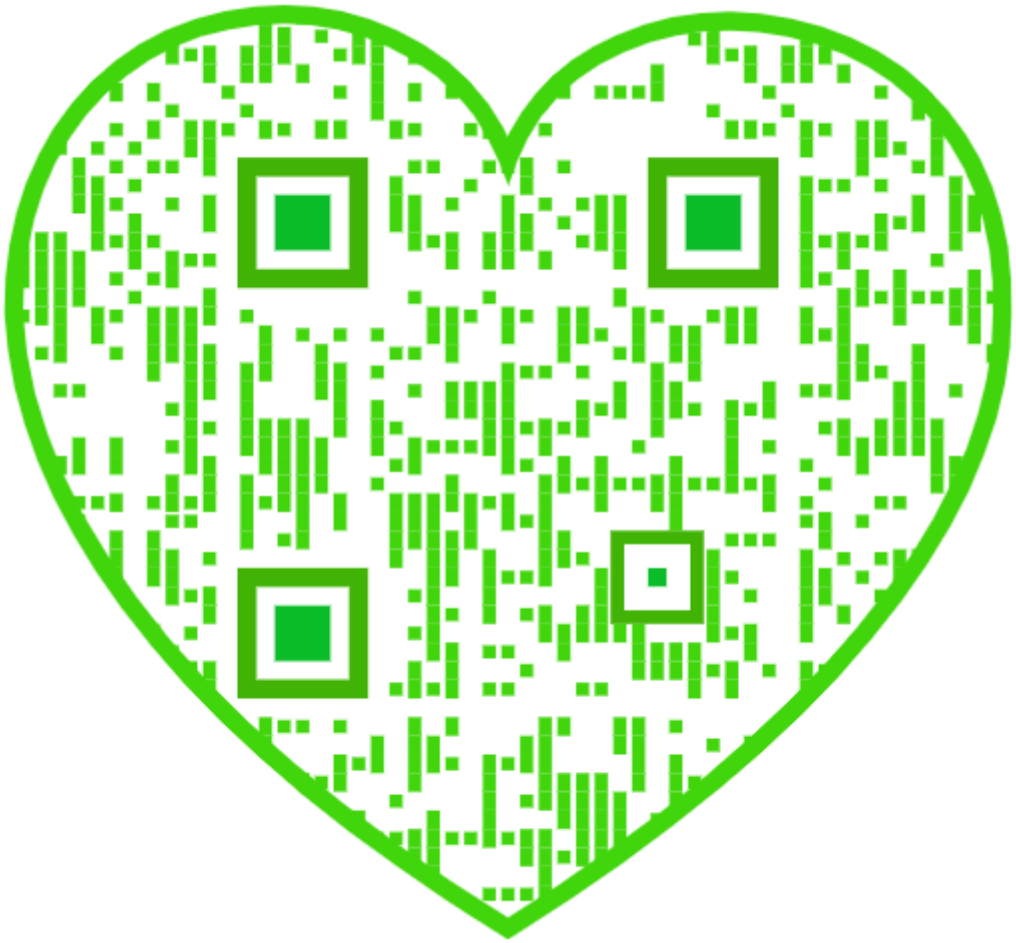

ZEPPELINS

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ZEPPELINS

THE PAST AND FUTURE

BY
EDWIN CAMPBELL

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LIST OF ILLUSTRATIONS

1.—Zeppelin L15 brought down by Gunfire and sunk in the Thames Estuary, March 31, 1916.

2.—Removing Parts of the ruined Schütte-Lanz Airship brought down in Flames by Lieutenant Leefe Robinson at Cuffley, September 2, 1916.

3.—Ruins of the Schütte-Lanz Airship destroyed by Lieutenant Leefe Robinson.

4.—Bow of Zeppelin L33 brought down by Gunfire in Essex, September 24, 1916.

5.—Oil Tanks of Zeppelin L33.

6.—Zeppelin L32 brought down in Essex, September 23–24, 1916.

7.—Bow of Zeppelin L32.

8.—Zeppelin L31 destroyed by Lieutenant Sowrey at Potters Bar, October 1, 1916.

ZEPPELINS: THE PAST AND FUTURE

I

WHILE it may be said that the coming of the aeroplane in 1908 gave Europe five or six years' respite from war, the invention of the Zeppelin made that war inevitable to the extent that it was the instrument by which Germany, at her chosen time, proposed to overcome Great Britain's insular security. When French genius, supplementing the work of the Brothers Wright, with characteristic energy and acumen rapidly developed an aviation industry, no small portion of the national enthusiasm of our Ally for and support of the new move ment arose from an unerring perception that the flying machine was destined to play an all-important part in the next war—and for France there could be only one war. The impending shadow of that had grown and waned and yet grown again until the world apprehensively perceived that the bursting of the storm was merely a matter of time and Germany's opportunity or convenience.

By an instantaneous appreciation of the aeroplane, and a truly phenomenal success in exploiting it, France in 1910 secured a military weapon not in the German armoury. Later, by taking a commanding position in the manufacture of aeroplanes, and by almost monopolising their development for two years, she compelled Germany to halt in her war designs, to make good her deficiency, and definitely to put back in its scabbard the sword that had been almost unsheathed several times, and had been rattled ominously in and out of season.

A national substitute, so necessary to German military *amour propre*, apparently was accepted in the Zeppelin, the rigid airship which had been the dream and obsession of Count Ferdinand Zeppelin for ten years. When France had taken such a lead in aircraft that the remainder of the world temporarily was outdistanced, the German military authorities turned somewhat feverishly to the Zeppelin to restore their prestige and to prove that German capacity to surpass all others in the appurtenances of war remained undiminished. But while the Zeppelin was thus acclaimed, the aeroplane was adopted also, and while others were designing, experimenting, and building it for sport and with scientific ends in view, Germany grimly set about developing it for the purposes of war.

When, however, early in 1909, Count Zeppelin handed over his first military airship to the German Government and it was found successful to a degree, a considerable section of expert opinion in Germany decided that the superior of the aeroplane for military purposes had been discovered; and despite, or rather because of, a series of failures and catastrophes, she secured just such a lead in rigid-airship construction as France had obtained in aeroplanes, with the added advantage that it was much more difficult to overcome or equal. Those catastrophes, coupled with a tremendous advance in aeroplane design and performance, had induced other nations to believe that the aeroplane was the better, as it was the more attractive machine, and while France, Italy, and Great Britain devoted some attention to non-rigid types of airship, the rigid was, broadly, regarded as Germany's preoccupation.

Profiting by this, Germany closed the doors of her airship factories to the outer world and allowed none to overlook her progress. Inside two years most of the earlier difficulties of construction were left behind, and from that point up to the capture of L33 in Essex on September 24, 1916, we knew relatively little that was

reliable or authentic concerning the nature and character of its subsequent development. Its records were announced from time to time in the German Press, evidencing an advance in efficiency and reliability that was remarkable, but the occasional catastrophe, still recurring, apparently convinced the experts of other countries that its design, fundamentally, was frail and unreliable in comparison with the aeroplane for the purposes of war.

In 1912 and 1913 tales of mysterious aircraft cruising by night over the Eastern Counties of England were accepted by a few as evidence of a somewhat startling development of the Zeppelin, but the Press ridiculed such ideas on the statements of experts who were accepted as possessed of a knowledge of the progress of contemporary airship development. At a dramatic moment, early in 1913, the commander of what was stated to be one of the latest creations of Count Zeppelin's factory at Friedrichshafen, Z4, lost his bearings during a trial cruise in the Rhine valley and descended on the parade ground at Lunéville in Lorraine. The vessel was detained pending "explanations," and when examined and its log overhauled by French aeronautical experts, it was evident that much of the advertised powers of the Zeppelin were imaginative.

Possibly history will decide, as many have now decided, that those nocturnal visitations over Norfolk and Suffolk were real, and that the Zeppelin descent at Lunéville with undestroyed log was a successful ruse to mislead France and the world at large concerning the technical and military value of the German airship. Certainly the details of its construction and equipment had no close relationship to the details of the Zeppelins brought down in England in 1916, and although three years may have effected all the changes, there is some, but not much, reason to believe that the Lunéville descent was a successful *ruse de guerre* intended to confirm the Entente military and naval experts in their disbelief in the airship as a

reliable or efficient aircraft for war, or as a practical foil to the aeroplane.

According to subsequent disclosures in the French Press, the Lunéville Zeppelin's log apparently proved that it could not ascend much above 6,000 feet, while its normal altitude was nearer 3,500 feet. Its average speed was about 45 miles per hour and its radius of action with full load less than 200 miles—figures all very much below the claims published in the German Press. Obviously, if its pilot could lose his bearings in a trip of less than 100 miles because of ground fog, it was not likely that he could lay and keep a course from and to Heligoland at night, involving nearly 500 miles of ocean navigation. Clearly, then, the French aeroplane was an infinitely superior military device. And so the Zeppelin almost ceased to trouble our experts, and to all appearance was lost sight of subsequently in the activity of aeroplane rivalry.

That, practically, was the position as it presented itself to the Allies when war broke out in July, 1914. Probably by then the weaknesses of the Zeppelin had been laid bare, and we know that early in 1915 it had been improved in speed up to about 50 miles per hour in still air, its structural weaknesses remedied to a considerable extent, and its load-carrying and ascensional power augmented by enlarging the gas container and improving its lines. But the aeroplane, relatively, had been much more developed in the interval. Its speed had been raised to 100 miles per hour, its reliability immeasurably improved, and the skill of pilots so increased by experience that little further progress in that direction seemed possible. By comparison it was the superior of the airship in every way save load-capacity and rapidity of ascent, and on the surface of things it appeared to justify the dictum of a French expert who asserted that inside six hours of its appearance in the fighting line any German airship would be destroyed by gunfire or aeroplane attack. That assertion predicated daylight and the employment

ZEPPELIN L15, BROUGHT DOWN BY GUNFIRE AND SUNK IN THE THAMES ESTUARY, MARCH 31, 1916

[*Facing p.* 8

REMOVING PARTS OF THE RUINED SCHÜTTE-LANZ AIRSHIP BROUGHT DOWN IN FLAMES BY LIEUTENANT LEEFE ROBINSON AT CUFFLEY, SEPTEMBER 2, 1916

[*Facing p.* 9

of airships in consonance with the recognized usages of civilized war, neither of which conditions Germany willingly fulfilled.

After a brief and disastrous experience in the early months of the war, during which four Zeppelins were destroyed, including one by French gunners at Badonviller in the Vosges, and another at Mlava in Poland by a Russian battery, the daylight use of Zeppelins in land operations was practically abandoned. The first five months of the war had been a continuous record of German airship losses without any adequate military recompense. During that time, according to Press reports, six Zeppelins and four other Austrian and German dirigibles were lost or destroyed in very subsidiary operations.

In January, 1915, began the series of Zeppelin raids on England which first demonstrated the advance that had been achieved in the construction and use of the naval Zeppelin—a type designed and developed for the single purpose for which it was reserved and used—compared with which the Lunéville Zeppelin was a crude and primitive affair. Not only had speed been increased to 60 miles per hour, but an altitude of about 13,000 feet was possible and a continued voyage at a height of 8,000 feet maintainable. The manœuvring power had been so improved that, without shedding ballast, vertical and horizontal direction within considerable limits could be altered with great rapidity and certainty, while the radius of action with a full load was extended to 500 miles. Probably as the result of patient and continued training and experiment for years previously, its navigation was so mastered that raids on the Eastern coasts of England, involving over 600 miles of travel during darkness, could be entered upon with approximate success. Undoubtedly, there were grave risks attaching to these expeditions, quite apart from the hostility of British warships and land defences, and several Zeppelins were lost through storm and mechanical failure.

It was not until March 31, 1916, that a raiding German

airship was destroyed by our gunners, our effective defences apparently being confined, up to that point, to the use of artillery guided by searchlights. Even in these we were heavily handicapped by the demands of our vastly increased land and sea forces and the calls of our Allies for guns and searchlights needed on all the fighting fronts. While admittedly unsuccessful in bringing down the raiders, those defences were very effective in driving them off and in compelling them to travel at such altitudes that they could have no definite idea of the results of their bombs, or of their actual location when using them.

II

IT is essential when discussing the subject of German air raids in general, and Zeppelin raids in particular, to recall the pre-war conception of the punitive uses to which these craft might legitimately be put. First, according to the accepted usages of civilized war, as embodied in the Hague Convention, no bombardment of an open town might be attempted without sufficient warning to enable the civilian population to evacuate it. Secondly, no attack might be made on an undefended or non-military town situated outside the sphere of active military operations. Thirdly, civilian lives and property were held sacred in the absence of any overt hostile act on the part of the populace. It was because, almost without exception, our East Coast towns were open and undefended in a military sense that from the beginning it was not considered essential to arm them against bombardment from the air or sea. Their best defence ought to have been their utter defencelessness. But the whole conduct of war by Germany invites the suggestion that it was precisely because they were in this condition that the German authorities planned, instituted, and carried out their series of outrages by air under the pretence of

military operations, but really to terrorize the civilian population.

Their earlier experiences in France, Belgium, and Russia had taught them the helplessness of airships in the presence of suitable artillery. Knowing that our towns and cities were unarmed, and calculating that, under the extremely heavy pressure of the vital demands of our own and our Allies' armies in the field and our greatly augmented navy, there would be considerable delay in organizing artillery defences for them against aircraft, they launched their plan to terrorize the civilian population of England by a series of brutal and wanton attacks on life and property. That they were well aware of the infamy of their acts is proved by the absurd announcements made in their naval bulletins issued after each raid that "fortified" towns like Cromer, Southend, Yarmouth, Ipswich, Ramsgate, etc., had been bombarded. None knew better than the German naval authorities that in these early days those towns were innocent of fortifications or artillery, and the suggestion that they were armed and garrisoned for defence is all the evidence necessary to convict them of as foul a violation in its way of the rules of war as the calculated ferocity of the bestial and revolting ravages carried out by German commanders in Belgium and France under the lying pretext that the civil population there had used arms and committed overt acts of hostility.

Obviously the gloss was intended to anticipate neutral comment or protest by putting the onus of disproof on Great Britain. Later, when the piratical purpose of the raids became only too evident to the British people, and such anti-aircraft artillery as was available was mounted to keep the raiders at a distance likely to minimize their offensiveness, the fact that these guns were used was paraded by the German authorities as proof that their prior contention was justified, and that our seaside resorts actually had been fortified places and London a defended arsenal —a form of demonstration similar to that used to legalize

the invasion of Belgium and to prove that the massacres of French and Belgian citizens of all ages and both sexes were justifiable acts of punishment or were even compelled in self-defence—Æsop's fable rewritten with sardonic savagery!

Here it may be pointed out that evidence of German pre-war preparation for these raids is not wanting. For years prior to 1914 the leading rubber company of Germany, which had secured a London headquarters, a very complete network of commercial agents in every town and village in the United Kingdom, and a considerable trade, maintained a large balloon—ostensibly for sporting and advertisement purposes in connection with the programme of the Aero Club of Great Britain. Invariably its ascents were made when the course from London could be laid up to the East Coast, or down to the Channel. Quite often the crew included an official of the German Embassy, and always an expert photographer whose snapshots of Kent, Sussex, Essex, Suffolk, and Norfolk may have been the ground plan from which the Zeppelin raids of 1915, 1916, and 1917 were projected and navigated.

While the earlier raids were launched from Heligoland and the Weser mouth, later ones started from behind the German-Belgian frontier. The primary reason for that change probably was a need to shorten the distance to England so as to admit a deeper penetration, or, in the alternative, a longer cruise over her coasts. In doing this, the return journeys frequently included a violation of the neutrality of Holland (since the air above any country is portion of its territory), yet another proof how little Germany regards her obligations to countries which cannot compel her to fulfil them. For these no apology nor any excuse was ever forthcoming.

In the characteristic German way somewhat elaborate justifications for the promiscuous sowing of incendiary bombs over business districts and the deliberate dropping of high explosives on densely inhabited areas in England have been published. Thus in *Zeppelin im Weltkriege*

(*Zeppelin in the World-War*), dedicated by the author, Arnold Jünke, to the late Count Zeppelin, it is stated that

> the object of the successful attacks made by our naval airships on England's chief towns and their environs is a *military* one. The aim is to destroy important military positions (*Anlagen*) in the London district; to prevent the use of certain convenient traffic arrangements which are of service for the concentration of troops; but above all to endanger London itself as the most important post on the economic line of communication of the English military forces.

The sophistry of the first and second reasons is exposed by the third, which in itself renders them as superfluous as they are untrue. The destruction of London, simply because it is London, that is the frankly avowed aim. Despite this candid admission of German desire to devastate London, and indiscriminately to murder its citizens on the plea of a military object, angry protests and accusations of a savage violation of the amenities of war were levelled in the German Press at the Allies when subsequently, and as a retaliatory measure, they bombed Karlsruhe! And when it was ascertained that one of our naval air pilots inadvertently had crossed Swiss territory in the course of that raid, though not observed by the Federal authorities, Germany had the hardihood to address a protest to the Swiss Government on the subject, which elicited an admission and apology from our Foreign Office.

Count Zeppelin was invoked to justify the blind and undeniably promiscuous dropping of bombs in night raids in an interview given to the notorious Karl H. von Wiegand, thus:

> They say we cannot always see our target from the great height at which we sail. But the same is true of the artillery, especially of howitzers. Does it not often happen that shells strike undefended parts of a town and fall on people who take no part in the war? The Zeppelins are just as anxious to save women and children

> as are the officers and gunners of our artillery. . . . A proof of this is the unexploded bombs which have been found in English towns. If Zeppelins are discovered by the enemy and subjected to a violent bombardment it may be of the greatest importance to ascend as quickly as possible; and in order to do so it may be necessary to throw out bombs as ballast. In that case the detonators are removed as far as possible to prevent a bomb which might fall on non-combatants from exploding.

That was meant for American consumption, but contains no essential truth beyond the possible fact that German commanders of Zeppelins are "just as anxious" as their artillery comrades to spare women and children. Those nations that have had close experience of both German methods of waging war will remark that neither have ever appeared to carry this anxiety too far. And it remains a curious fact, testimony to which is to be found in the ruined shrines of Belgium, France, Italy, and Poland, that German artillerists either have been particularly unfortunate in dropping shells where they were not intended, or their target practice has been wretchedly unsound. But to compare the mathematical accuracy of observed artillery fire with the haphazard dropping, in the darkness of night, of a series of Zeppelin bombs is as ridiculous as to assert seriously that any bomb dropped from a Zeppelin in England first had its detonator removed. Dozens of these unexploded missiles have been found, but each had its detonator set for business. On the whole, though equally unveracious, there is more candour in the confession of Arnold Jünke in *Zeppelin im Weltkriege* when he says:—

> The air war against England strikes us as a just retaliation [for the British sea blockade] since it enables us not only to achieve military results, *but also to hit English economic life in its most sensitive spot.*

No act however wanton, no crime however barbarous, need require justification if that doctrine be accepted. To murder the citizens of an enemy by whatever means

under whatever circumstances, to burn their homes, to destroy their business and commercial districts with thermite and T.N.T., all fall within its apologia. Clausewitz did not live nor write in vain. His gospel of ruthless savagery and invocation to "shut the gates of mercy on Mankind" when engaged in war, has from the beginning stimulated every German act when the fear of consequences has not counselled an infrequent regard for humanity. Hostilities were not many days old when German Zeppelins were despatched by night to endeavour to bomb the Antwerp palace of the King of the Belgians, who was known to be in residence. Buckingham Palace shared with the Bank of England the particular attention of the Zeppelin commander Mathy on September 8, 1915, when he attacked London. Indeed, the German people were induced to believe that both had been hit on that occasion, and as far away as Persia German accounts of the affair graphically described the act.

The tidings gave rise to such evidence of popular satisfaction in Germany as to indicate that the German people were prepared to accept any form of warfare their naval and military commanders could prosecute with success. There is no room for sportsmanship, no use for chivalry, in the German code of war. The felon blow is specially favoured by it because it is likely to be more effective than any other. When the Austro-German-Bulgarian armies were overrunning Roumania it was in the fitness of things that Zeppelins should have been sent ahead to bomb Bucharest, and in particular the palace of King Ferdinand; and when Allied air raids on Karlsruhe were anticipated, British and French prisoners of war were confined in close proximity to the Grand Duke of Baden's palace, to intimidate any attempt on that building.

III

FROM the outbreak of war down to the present time (April, 1918) there have been 48 separate Zeppelin raids on this country, in addition to others which, for some reason, were not completely carried out, the airships not reaching our shores. A full list, with indications of the localities attacked, together with the casualties resulting, is given on pp. 17–19. For comparison the German claims are given, although they are often of an inflated and even farcical character.

It will be seen that the German authorities claim to have bombed London no less than twenty times, and it is to be surmised that this indicates their objective—which their raiders so seldom reached. But the most fantastic claims are those of having attacked Liverpool, Birkenhead, Manchester, and other places which a Zeppelin bomb has never yet reached except as a museum trophy. All these statements were made with much display of circumstantiality and detail, no doubt relying upon the compulsory reticence of the official British reports to carry conviction to neutrals. That reticence has been much criticised, but has been justified by the obvious inability of the Zeppelin commanders to improve in subsequent raids on their previous navigation, and so greatly helped to render abortive no less than thirteen of their expeditions. We call them abortive because they caused no damage worth recording and were not attended by any casualties. Of the remainder all but ten could be dismissed as mere haphazard house-bombing affairs.

The entire series caused the deaths of 435 persons and injured 1,069 others, the great majority being women and children. A considerable amount of damage was done to private property, which we know is always a gratifying fact in German eyes; but it is remarkable, in view of the large number of high-explosive and incendiary bombs discharged, that even by chance no naval or military damage was effected. It is no exaggeration to say that

ZEPPELIN RAIDS ON ENGLAND, 1915–1918

DATE	DISTRICT	GERMAN CLAIMS	CASUALTIES	
		1915	Killed	Wounded
Jan. 19	Yarmouth and King's Lynn	Yarmouth, Cromer, Sheringham, King's Lynn	4	16
Feb. 21	Colchester	No claim	—	—
Apr. 14	Blyth and Tyneside	Wallsend, Hebburn, Blyth, Bedlington, Morpeth	—	2
,, 16	Lowestoft and Maldon	Maldon, Heybridge, Southwold, Lowestoft, Burnham, Yarmouth	—	—
,, 30	Ipswich and Bury St. Edmunds	Ipswich, Bury St. Edmunds	—	—
May 10	Southend	Southend, Westcliff, Thames mouth	1	2
,, 17	Ramsgate	Ramsgate, Folkestone	2	1
,, 27	Southend	No claim	3	3
,, 31	Outlying districts of London	London	7	35
June 4	East and South-East Coasts	Humber mouth, Harwich	—	8
,, 6	East Coast	Hull, Grimsby	24	40
,, 15	North-East Coast	Shields, Elswick-on-Tyne	18	72
Aug. 9	East Coast	London, Thames mouth, Harwich, Humber	17	21
,, 12	East Coast	Harwich	6	24
,, 17	Eastern Counties	London, Woodbridge, Ipswich	10	48
Sept. 7	Eastern Counties and London	London	18	39
,, 8	Eastern Counties and London	London, Norwich, Middlesborough	26	94
,, 11	East Coast	London	—	—
,, 12	East Coast	London	—	—
,, 13	East Coast	Southend	—	—

DATE	DISTRICT	GERMAN CLAIMS	CASUALTIES	
			Killed	Wounded
Oct. 13	Eastern Counties and London ..	London, Ipswich	71	128
		1916		
Jan. 31	Midland Counties	Liverpool, Birkenhead, Manchester, Sheffield, Nottingham, Birmingham, Humber and Yarmouth	70	113
Mar. 5	Yorkshire and seven other Counties	Hull	18	52
,, 31	Eastern Counties and North-East Coast	London, Enfield, Waltham Abbey, Stowmarket, Lowestoft, Cambridge, and Humber	48	64
Apr. 1	North-East Coast	Teeside, Middlesborough, Newcastle ..	22	130
,, 2	S.E. Scotland, N.E. Coast and Eastern Counties	London, Edinburgh, Newcastle	13	24
,, 4	East Anglian Coast	Great Yarmouth	—	—
,, 5	North-East Counties	Whitby, Hull, and Leeds	1	9
,, 24	Eastern Counties	Cambridge, Norwich, Lincoln, Winterton, Ipswich, Harwich	1	1
,, 25	Essex and Kent	London, Colchester, Ramsgate	—	1
,, 26	East Coast of Kent	London, Colchester, Ramsgate	—	—
May 2	N.E. Coast and S.E. Coast of Scotland	Middlesborough, Stockton, Sunderland, Hartlepool, Firth of Forth	9	30
July 29	East Coast	Lincoln, Grimsby, Immingham, Hull, Norwich	—	—
,, 31	Eastern and S.E. Counties	London, Thames mouth [Winterton	—	—
Aug. 3	Eastern Counties	London, Harwich, Norwich, Lowestoft,	—	—

DATE	DISTRICT	GERMAN CLAIMS	CASUALTIES	
			Killed	Wounded
Aug. 8	Eastern and N.E. Coasts	Tyneside, Whitby, Hull, Grimsby, Humber, King's Lynn	10	16
,, 23	East Suffolk	.. ..	—	—
,, 24	Eastern and S.E. Coasts	London, Harwich, Folkestone, Dover	9	40
Sept. 2	Eastern Counties and Midlands	London, Yarmouth, Harwich, Humber	4	12
,, 24	London and District and Midlands	Portsmouth, Thames mouth, York, Leeds, Lincoln, and Derby	40	130
,, 25	Lancashire, Yorkshire, Lincolnshire	.. ..	43	31
Oct. 1	North-East Coast	London and Humber	—	1
Nov. 28	North-East Coast	.. ..	4	37
		1917		
Mar. 16	Kent	London	—	—
May 23	Norfolk	Fortified towns in England	1	—
June 16	Suffolk and Kent	.. ..	3	16
Aug. 21	East Riding	.. ..	—	1
Sept. 24	Yorkshire, Lincolnshire, Kent, Essex and London	London, Hull, Nottingham, Birmingham, etc.	—	3
Oct. 19	London	London, Manchester, Birmingham, Nottingham, Derby, Lowestoft, Grimsby, Norwich, Mappleton	36	55
		1918		
Mar. 12	East Yorkshire	Hull and Whitby	1	—
,, 13	North East Coast	Hartlepool and Tynemouth	8	39
Apr. 12	Eastern Counties and N. Midlands	Leeds, Nottingham, etc.	5	22

in all about 700 tons, representing 5,000 bombs, must have been dropped; and that they caused no more than 1,504 casualties, and material damage to the value of about £1,400,000, must surely be disappointing to the nation that acclaimed it a great naval success to have sunk the *Lusitania*. In that glorious exploit more defenceless civilians were murdered and more property was destroyed by the expenditure of two torpedoes than has been effected in three and a half years of costly Zeppelin raids.

It is estimated that forty of the naval type of Zeppelin have been built specially for the purpose of raiding this country, at a cost of about £140,000 each. Those represent a capital expenditure of £5,600,000 in ships and another £2,000,000 in sheds and the necessary repair shops and machinery for gas production. Each Zeppelin is computed to cost £240 per diem to keep in commission, as, in addition to the crew of about twenty aeronauts and mechanics, there are large squads of trained soldiers attached to each airship base, numbering about 150 per ship, while repairs are said to cost about £15,000 per annum in peace time. It is estimated that no fewer than twenty-four Zeppelins have been destroyed by the Allies or lost as a consequence of damage sustained in attacking the Allied countries, while a number of others have been seriously damaged. In all, about 180 naval Zeppelin units have been dispatched against us, but it is not probable that at any one time the strength of the enemy in these craft has much exceeded twenty ships. Accepting that as an average, over nearly three years of war it represents an approximate expenditure of £5,250,000 in maintenance, and as each raid would entail a further expenditure of £2,000 per ship in gas, fuel, bombs, and trial trips, there has to be added another £360,000, together with £100,000 for subsidiary but consequential services.

On these calculations Germany has spent fully £13,250,000 on Zeppelin raids, and at the most conserva-

tive estimate £9,600,000 of it has disappeared. When it is borne in mind that a considerable concentration of German effort was bound up in this enterprise that, as events have proved, could more profitably have been diverted to other affairs, it will be seen that these figures alone do not embrace her effective loss. Even in casualties she has to admit the deaths of about 250 trained aeronauts and engineers, of greater moment to her, probably, than the 435 persons whom they helped to kill were to England, while the million pounds' worth of property destroyed and the relatively small number of troops immobilised for defence were a poor result for the expenditure of over nine and a half millions of capital.

Those figures present a very different picture from the highly-coloured and decorative speculations and inventions of the German official bureau and press, but they bring the whole scheme into a perspective which enables a judgment to be passed on its military value. That judgment, quite apart from questions of outrage, or the violation of the amenities of civilization, cannot be other than adverse. Beyond the detention in this country of a number of gunners and air-pilots, few of whom, however, had been wholly detached for this special purpose, and the occasional interruption of war work in some districts for a few hours, there have been no military results apart from the killing and maiming of a few soldiers.

Looked at impartially, the Zeppelin raid programme has been a fiasco. Morally it has been a great German blunder, because its effect has been incalculable in creating and fostering an abhorrence of German brutality and mentality, which has been of priceless service to the Allied cause in stimulating the British nation to the stupendous efforts it has made in the cause of civilization during the past three and a half years. It greatly helped to reconcile the mass of the British people to the acceptance of burdens, and a surrender of liberties, which the enemy judged would never be made. It is safe to assert that it has done more to make war with Germany a national

effort than anything else in the long black list of German atrocities, while its effect on the opinion and attitude of the world at large undeniably has been of great disservice to Germany. It demonstrated to those outside the conflict that the German conception of legitimate war is restrained by no consideration of humanity, of honour, of reputation; and the balanced mind recoils in horror from a nation which thus, after a thousand years of civilization, deliberately reverts to a barbarism and a ferocity beside which the excesses of the Huns of old appear pale and almost ineffectual.

The mendacity of the German official claims is so truly "colossal" that it is like chasing a will-o'-the-wisp to endeavour to track them down, but it is as well to give a few selected examples.

On July 4, 1915, the German Army Headquarters in Berlin issued the following, which was wirelessed to neutral countries (*vide The Times* Amsterdam Correspondent, July 5, 1915):—

> Our airmen yesterday were very active. German aircraft dropped bombs on the Languard Fort of Harwich and upon an English flotilla of destroyers.

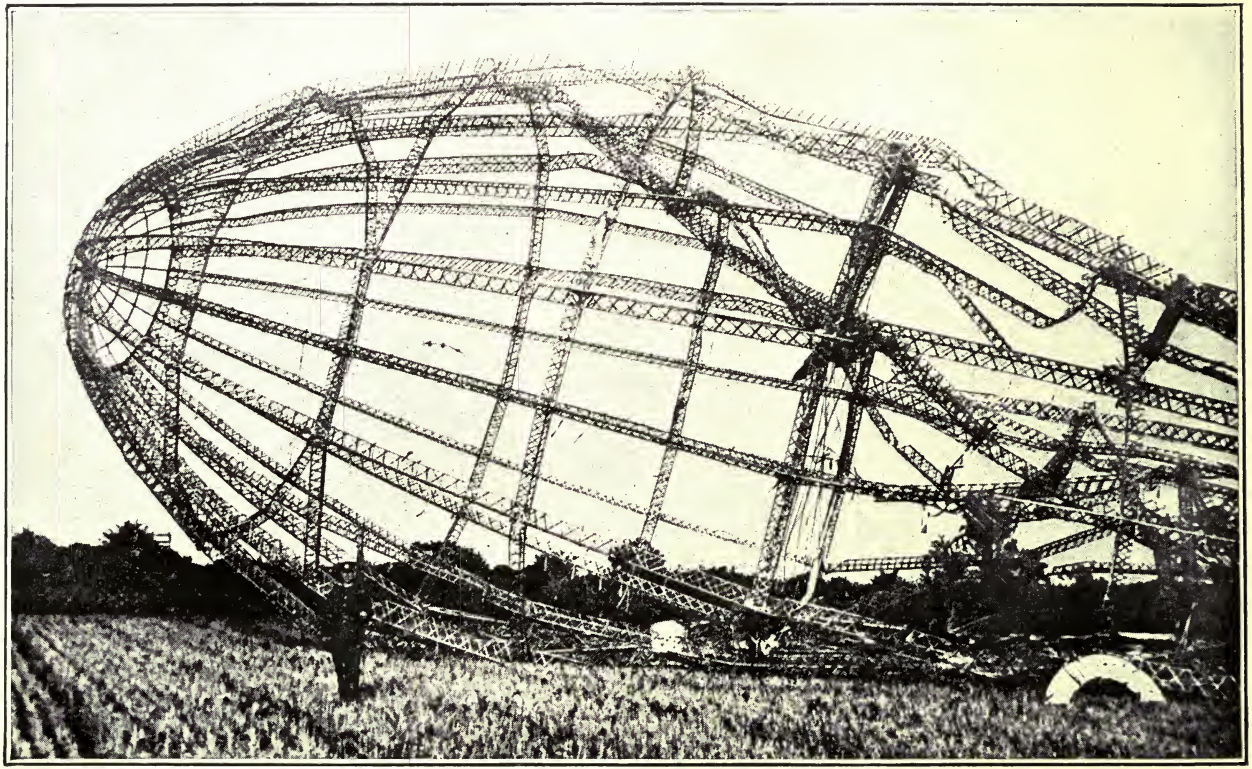
The mendacity of the claim is proved by the fact that in a subsequently compiled German semi-official list of air raids on England this one is not mentioned.

The following interestingly imaginative description of his exploits over London in the raid of September 8, 1915, was given to the Berlin Correspondent of the *New York World* by Commander Mathy, who, by the way, was killed in command of L31 when it was brought down in flames at Potters Bar by Lieut. Sowrey on October 1, 1916. He was a veteran Zeppelin pilot who claimed to have made over a hundred air voyages.

> It is a cold, clear, starlit night, and there is no moon — one of those nights when the distances of objects in the sky are illusive and difficult to get the range of, but our instruments tell us exactly how high we are.

RUINS OF THE SCHÜTTE-LANZ AIRSHIP DESTROYED BY LIEUTENANT LEEFE ROBINSON

[*Facing p.* 22



Bow of Zeppelin L33, Brought Down by Gunfire in Essex, September 24, 1916

Oil Tanks of Zeppelin L33

ZEPPELIN L32, BROUGHT DOWN IN ESSEX, SEPTEMBER 23–24, 1916

[*Facing p.* 23

The mist disappeared. In the distance we could see the Thames, which points a way to London. It is an indestructible guide and a sure road to the great city. The English can darken London as much as they want, but they can never eradicate or cover up the Thames. It is the great point from which we can always get our bearings and pick up any part of London we desire.

That does not mean that we always come up along the Thames by any means. London is darkened, but it is so sufficiently lighted that on this night I saw it reflected in the sky forty miles away shortly before ten o'clock.

I headed straight for the glow in the sky and then for a point on the Thames to get bearings for my attacks. Soon the city was outlined in the distance. There were dark spots which stood out from the blur of lights in the well-lit portions. The residential sections were not much darkened. It was the dark spots I was after, and I bore down on them, as they marked the city.

London seen at night from a great height is a fairylike picture. We were too high to see the people in the streets. There was no sign of life except in the distance the moving lights of what were probably trains. All seems still and quiet and no noise ascends from below amid the spluttering of the motors and the whirring of the propellers.

As if in the twinkling of an eye all this changes. The sudden flash of a narrow band of brilliant light reaches out from below and begins to feel round the sky. A second, third, fourth, and fifth soon move a score of criss-crossing ribbons. As viewed from the Zeppelin it looks as if the city had suddenly come to life, waving its arms around the sky and sending out feelers for the danger that threatens, but our impression is more that they are tentacles seeking to drag us to destruction. London keeps a good watch on the sky.

Our motors and propellers soon revealed our presence. First one, and then another and another of those ribbons shooting out from the glaring, eyelike searchlights pick us up. Now from below comes an ominous sound that penetrates the noise of the motors and the propellers. There are little red flashes and short bursts of fire which stand out prominently against the black background.

From north and south, from right and left they appear, and following the flashes rolls up from below the sound of the guns. It is a beautiful and impressive but fleeting picture as seen from above, and is probably no less interesting from below—the greyish dim outline of the Zeppelins gliding through the waving ribbons of lights and the shrapnel cloudlets which hang thickly.

But we have no time to admire; our eyes and mind must be concentrated on our work, for any moment we may be plunged below, a shapeless mass of wreckage and human bodies dashed into the unrecognizable. You saw it at Johannisthal (the aerodrome near Berlin) two years ago. I had so little time to register my impressions that I have to think back now to give you a descriptive word-picture of the scene.

When the first searchlight picks you up and you see the first flash of guns from below your nerves get a little shock, but then you steady down and put your mind on what you are there for.

I picked up St. Paul's and from that point laid a course for the Bank of England. There was a big searchlight in the immediate vicinity of St. Paul's. The English had placed a battery of guns under cover of the Cathedral. Although we had been fired upon from all sides we had not yet dropped a bomb. Above the Bank of England I shouted through the speaking-tube connecting me with my Lieutenant at the firing apparatus, "Fire slowly." Now, mingling with the dim thunder and the vivid flashes of the guns below, came the explosions and bursts of flames caused by our bombs. With the mind solely concentrated on picking out places previously on the programme for attack as being factors of military bearing, the comparatively short time spent above London appeared much longer than it actually was.

I soon observed flames bursting forth in several places. Over Holborn Viaduct and the vicinity of Holborn Station we dropped several bombs. From the Bank of England to the Tower—a short distance—I tried to hit the Tower Bridge, and I believe I was successful, but what was the extent of the damage I could not determine. Flashes from the Tower showed that guns were placed

there, which I had already observed during a previous attack. They were keeping up a lively fire.

Arriving directly over Liverpool Street Station I shouted: "Rapid fire," through the tube, and the bombs rained down. There was a succession of detonations and bursts of fire, and I could see that they had hit well and caused apparently great damage, which has been confirmed by reliable reports we have since received.

Flames burst forth in several places in that vicinity. Having dropped all my bombs, I turned my airship for home. My orders had been carried out quickly. Despite the bombardment of the sky we had not been hit. Several times I leaned out and looked up and back at the dark outline of my Zeppelin, but she had no hole in her grey sides.

In point of damage done and hitting the objects which I was instructed to attack it was my most successful trip over London or the vicinity. Ascending or descending until we found a favourable wind, we made a quick return.

The Home Office, in passing the foregoing article for publication, emphatically contradicted the assertion that anti-aircraft guns were mounted under cover of St. Paul's, and pointed out that Mathy's statement obviously was intended to provide an excuse for the outrage he had failed to perpetrate.

The raid on London of October 13, 1915, in which 42 men, 9 women, and 6 children were killed, and 77 men, 30 women and 7 children were injured, was thus acclaimed (*vide The Times* New York Correspondent, November 8, 1915):—

The East India Docks were attacked and a large shed full of ammunition was burned to the ground. At the London Docks a warehouse was destroyed, several ships were hit by bombs and some were destroyed. At Victoria Docks a large cotton warehouse was burned to the ground. In the same neighbourhood blocks of houses were destroyed or damaged in St. George's Street and Leman Street. The City, and particularly the newspaper quarter, was

bombarded with especially good success. The Tower of London and London Bridge, which was armed with guns, were bombarded. Houses—sometimes whole blocks of them—were damaged or destroyed in Liverpool Street, Chancery Lane, Moorgate Street, Bishopsgate, Aldgate, and the Minories. The London and South-Western Bank was burned to the ground. Much money, valuables, and papers are believed to have been destroyed. The *Morning Post* building was seriously damaged and a branch of a London Bank was reduced to ashes. Subway (Underground) and railway traffic was interrupted for a time owing to bomb damage.

Much damage was done at Woolwich Arsenal. In Enfield a battery with searchlights was silenced. The Hampton Power Station was hit. In Croydon extensive factories were hit and great fires were noticed. In Kentish Town an especially strong searchlight battery was noticed and bombs were dropped on it. A whole row of searchlights went out. At West Ham and East Ham the railway was bombarded. At Ipswich a battery was bombarded and its fire became noticeably weaker. A German airship was the object of unusually hot fire, but was not damaged. Four airplanes attacked the airship without success.

The truth is that neither the East India nor any other docks were bombed. The Tower of London and the Tower Bridge were not touched, and the damage done in the various streets named was mainly confined to windows and doors and the street pavements. The majority of the casualties occurred in the East End where the population is crowded in small and tenement houses—a class that, throughout, has borne the brunt of German frightfulness. The circumstantial details regarding Woolwich Arsenal, Enfield, Hampton, etc., were purely imaginative and doubtless were intended to lend verisimilitude to an otherwise bald and unconvincing narrative.

Of the raid of January 31, 1916, when more than 250 bombs were dropped over Norfolk, Suffolk, Lincolnshire,

Leicestershire, Staffordshire, and Derbyshire, and 67 persons were killed and 117 injured, the Berlin claim (*vide The Times* Amsterdam Correspondent, February 2, 1916) was that

> On the night of January 31st one of our naval airship squadrons dropped large quantities of explosives and incendiary bombs on the docks, harbour, and factories in and near Liverpool and Birkenhead, on iron-foundries and smelting furnaces, on Manchester factories, on smelting furnaces at Nottingham and Sheffield and the great industrial works on the Humber and near Great Yarmouth.
>
> Everywhere marked effects were observed in the gigantic explosions and serious conflagrations.
>
> On the Humber a battery was also silenced.
>
> Our airships were heavily fired on from all directions, but were not hit and safely returned.

The truth is that none of the raiding airships got near to Liverpool, or Birkenhead, or Manchester. There were no smelting furnaces in Nottingham to bomb, nor was Sheffield damaged. Some breweries, railway-sheds, a factory or two and the usual complement of workmen's dwellings, chapels, and churches were damaged.

On February 1, 1916, the German Wireless sent out a statement (*The Times*, February 8, 1916) to the effect that during the air raid of January 31, the

> small English cruiser *Caroline* was sunk by a bomb in the Humber with great loss of life during the last Zeppelin raid.

The British Admiralty promptly stated in contradiction that none of His Majesty's ships nor any merchant ship, large or small, had been bombed.

The Berlin account (*The Times*, April 3, 1916) of the raid of March 31, 1916, claimed that

> during the night of March 31–April 1 one of our airship squadrons attacked London and the South Coast of England. Bombs were freely dropped on the City

between Tower Bridge and London Docks, the military camps in the north-western district of the City, the manufactories near Enfield, and the munition works at Wath [*sic*] Abbey.

Another airship, after having successfully attacked a battery near Stowmarket, dropped a number of explosive and incendiary bombs on Lowestoft.

A further battery was silenced near Cambridge, the extensive manufacturing works of the town were attacked, and bombs were finally dropped on the fortification works and harbours on the Humber, whereby three batteries were reduced to silence.

All the attacks were successful, and reliable observations from the airships discerned the presence of numerous fires and the collapse of buildings.

In spite of violent bombardment all the airships returned, with the exception of L15, which, according to a report, was compelled to descend in the water of the River Thames. Searches instituted by our naval forces have, up to the present, not been productive of any result.

Every claim made in this statement was false. The attack on London was abandoned owing to the damage caused to L15, which was hit so badly that it came down in the Thames Estuary.

A typical instance of the manner in which prevarication is employed by the enemy to disguise defeat is seen in the following report issued by the German Naval Staff (*vide The Times* Amsterdam Correspondent, September 5, 1916):—

On the night of September 2nd, several naval airship squadrons dropped a large number of bombs on the Fortress of London, the fortified places of Yarmouth and Harwich, and factories of military importance in the South-Eastern Counties and in the Humber district.

The good effect of these attacks was proved by the fact that great conflagrations and explosions were everywhere observed.

All the naval airships returned undamaged. although they were strongly bombarded.

> Simultaneously an attack by army airships took place on the South of England.

It was on the occasion of this raid that a military airship was destroyed at Cuffley by Lieut. Robinson. So soon as the news of its destruction became impossible to conceal, the German Headquarters Staff issued the following :—

> During the night of September 2nd our naval and army airships attacked the Fortress of London and good results were observed.
>
> One of our vessels was brought down by enemy fire.

A final instance of tergiversation will now suffice. On March 16, 1917, some two or three Zeppelins, very obviously detached for purposes of diversion in connection with sea activities, visited a section of the South-Eastern Coast. No damage to houses or buildings and no casualties were caused by the discharge of some fifty bombs, yet this is the German official description of the raid (*The Times* Amsterdam Correspondent, March 17, 1917):—

> One of our naval airship squadrons, in spite of violent counter-attacks by hostile airmen and anti-aircraft guns, successfully dropped bombs on London and the South-Eastern Counties during an attack lasting half an hour. Our airships returned safely.

London was not visited, and there were no counter-attacks by British pilots for the good and sufficient reason that owing to heavy ground fog the raiders could not be sighted.

It will be evident to any sensible person that these German romances either indicate a total ignorance on the part of the airship commanders of their routes (and a consequent assumption which required elaborate details to satisfy the demands of the German people deluded into believing that England was devastated and terrorised), or, having obtained some local information through neutral sources, these fables were deliberately invented for an obvious purpose. The point to remember is that throughout no military damage was caused, that only

civilian life and property suffered, and that, in the end, failure had to be admitted. Count Zeppelin himself shortly before his death was reported in the Swiss Press to have confessed the futility of attempting further attacks on this country in face of the danger involved by the efficiency of our air and artillery defences.

IV

AS has been explained in an earlier chapter, two circumstances for some considerable time affected detrimentally the defence of England against night-raiding Zeppelins. The first was a temporarily irremediable shortage of guns and gunners, the second was incomplete knowledge of the aeronautical capacity and powers of the types of airship employed in these raids. From the beginning of the war the enemy boasted of the destruction he was going to accomplish in England with his Zeppelins, and we were under no misapprehension concerning that intention. The nocturnal attacks on Antwerp in August, 1914, clearly indicated the form raids on us would take, and such defences as could be improvised were set up when it became evident that such raids were a part of the German programme.

Had the information gathered from the log of Z4 been reliable, the defences would have proved fairly efficient. They consisted of small-calibre naval guns, supplemented by naval searchlights. We had no special anti-aircraft guns in our equipment, as Germany had, for the simple reason that, as we harboured no warlike designs in 1914 or preceding years, we had not anticipated attack from any Continental air power. The progress of aeronautical science and its application to military purposes had been so rapid in the period immediately preceding the war that our ordnance direction had not had time, even had they the necessary conditional data, to produce such artillery. Our gunners had no experience of anti-aircraft work ; but, in view of the seemingly reliable data supplied

by the Lunéville Zeppelin's log, the task of hitting an airship was not considered outside the powers of an expert gunlayer using a light naval gun with an effective horizontal range of 7,000 yards, and assisted by searchlights. French 75s had been sufficiently powerful to damage and bring down Z8 which had attempted to operate against our Ally at Badonviller in August, 1914.

But the Zeppelins that were sent to raid England were very different craft from Z4 and Z8, and our gunners discovered that their target was more elusive than its estimated speed and powers of ascent warranted, while longer-ranging weapons obviously were required. And at a time when the demands of the Admiralty and the War Office for heavy ordnance to equip the considerable additions we were making to our Fleet, our Army, and the forces of our Allies were insistent, we were without any immediate power to remedy the situation by mounting guns of greater calibre, except at certain points where it was imperative that raids should not be made without very great risk.

Accordingly we had to be content for over a year to endure the Zeppelin attacks and by various measures attempt to reduce their effectiveness; and that they could not effect better results in the circumstances is not greatly to their credit. By that time the pressure of the demand on our ordnance factories had been sufficiently diminished to admit of special attention being devoted to the Zeppelin and its work, and in the interval our searchlight and aeroplane equipment had been steadily improved, so that when the turn of the tide came the Zeppelin-raid bubble was quickly pricked.

The first palpable success of our land defence was scored against the raid of March 31, 1916, when, during an attack directed against the Eastern Counties and London which failed to reach the latter, one of the raiders was so badly damaged by gunfire that, although it managed to get away for the time being, it eventually fell, a wreck, into the sea at the mouth of the Thames.

Before this, however, a policy of attacking the Zeppelins in their bases had been inaugurated by the Admiralty with considerable success. On November 21, 1914, British naval pilots made a successful aeroplane raid on Friedrichshafen on Lake Constance, the then headquarters of Zeppelin construction, and an airship was destroyed. Towards the end of December another aeroplane raid was made on the Zeppelin sheds then being constructed near Brussels, and the great naval air base at Cuxhaven was also bombed. Zeebrugge was bombed several times, and Hoboken at Antwerp, also used as an airship base, was heavily raided twice in March and April, 1915. On June 7 a double success was scored, for Lieut. Warneford, R.N.R., in an aeroplane intercepted and destroyed near Bruges a Zeppelin returning from a raid on the South-east Coast, while the remainder of his squadron sought out and destroyed another Zeppelin in its shed at Evère, near Brussels.

These successes induced the Germans to withdraw their airship bases from Western Belgium. Meanwhile the raids on England apparently continued to escape punishment, but it is known that on several occasions the raiders got home in a damaged condition. One, L19, was lost in the North Sea off the East Anglian coast, and reports from the Continent announced other losses indirectly due to operations undertaken against England.

It was not until September 2, 1916, however, that a satisfactory solution of the problem was found. On that date the greatest raid of German airships yet made was carried out, covering the whole East Coast and penetrating into the Midlands and down to London. In all, some eighteen units were employed, several of them being obviously earlier models. One of these, as already mentioned, while making to attack London was engaged by anti-aircraft guns near Barnet and by Lieut. Robinson, R.F.C., in an aeroplane. The latter, though heavily fired upon from the Zeppelin, succeeded in getting home an incendiary bomb which set the gasbag alight, and the airship

fell to earth in flames and was consumed near the hamlet of Cuffley in Middlesex. Apparently incredulous that their elaborate construction, designed and considered successful against attack of this description, should have been proved vulnerable, another raid was dispatched against London three weeks later, with the result that L32 was brought down in flames and L33 was so damaged by gunfire that it was compelled to descend in Essex and its crew surrendered. Still persisting, a week later yet another, L31, was brought down in flames at Potters Bar, just north of London. Military pilots using fast-climbing, night-flying aeroplanes, equipped with special bombs, proved that the Zeppelin is an easy prey when properly attacked.

After that London was given a wide berth. But the spell had been broken, and when the East and North-east Coasts were raided on November 27, 1916, two more Zeppelins were destroyed, in each case after having been hit by our artillerists. One fell into the sea off Hartlepool and its crew were drowned. The other was brought down in flames nine miles out at sea from Lowestoft by naval airmen after being hit by the guns on shore.

These continuous losses, accompanied as they were by relatively insignificant results, convinced the enemy that, despite all his labour and ingenuity, the usefulness of the airship as a weapon of military offence on the lines hitherto employed was effectually dissipated, and might henceforth only be used for such purposes when its loss was not the greater evil. Examination of the wrecks of the vessels brought down in Essex, one of which was virtually intact save only for its envelope and the damage caused by our shells, disclosed the great difference between these craft and the Lunéville Zeppelin of 1914.

Calculating, doubtless, that their long abstention from raids had led to a relaxed defensive vigilance, the Germans four months later launched an expedition against London on the night of March 16, 1917. This actually reached Kent but was entirely futile, and ended in one of the raiders, L39, being blown across the Channel out of her

course. She got as far as Compiègne, near Paris, where she was discovered by the French anti-aircraft gunners and brought down in flames. Still persevering, after another two months' preparation Zeppelins crossed the Norfolk coast again on May 23, but ground fog both saved them from attack and prevented them from doing any damage. A further attempt on June 16 ended disastrously, for L48 was caught in our gun and aeroplane barrage and brought down in Suffolk. Three of her crew were made prisoners; the remainder perished.

That seemed to have convinced even the most obstinate German enthusiast that the airship as a raiding machine was a failure, for the next four months, though presenting many favourable nights, were undisturbed. But the Hun was not yet satisfied, and he attempted a fresh ruse, with terribly disastrous results to himself. On the night of October 19th one of the most formidable of all these raids was launched from the North Sea bases, no fewer than thirteen naval Zeppelins being employed. Apparently they met at a pre-determined point and, taking advantage of a north-east wind, shut off their engines at a safe altitude and drifted over the Midland and Eastern Counties of England, sowing bombs as they passed.

The surprise was undoubted; but the end was retributive. The wind had increased to a gale of extremely low temperature which, besides offering alarming resistance to airship navigation, appears to have frozen some of the carburettors and the water-jackets of the engines of quite half a dozen ships during the drifting, so that, when required, they were found useless. Four ships proved to be helpless to do other than float along on the gale, and when morning broke they found themselves across the Channel in France, where they became targets for the French airmen and gunners. L49 was forced to ground and captured at Bourbonne-les-Bains. L50 was damaged and driven across the length of France, fell into the Mediterranean and was totally lost. L45, damaged by gunfire, got as far as Sisteron, 75 miles south of

Grenoble, with great difficulty, and there came down and was burnt by its commander. Another, L44, was brought down at St. Clément, near Lunéville, by anti-aircraft gunfire.

That anti-climax virtually represented the end of Zeppelin raiding activity against England, for the timid tip-and-run visits to the Yorkshire coast on March 12 and 13, 1918, are not worth considering. On April 12, however, a more formidable attack was launched against the North of England, which nevertheless did very little damage. Whatever fresh designs may be harboured, we may rest assured that all the ingenuity of the German constructors and tacticians will prove useless against the apparatus now employed by the Allies, and while Zeppelins may still be used for raiding purposes they will not, save in extremity, invite the attack of aeroplanes or seaplanes. In no single reported instance where the aeroplane has got home has the Zeppelin escaped, and that knowledge must act as a wholesome deterrent to any promiscuous or general policy of raids against defended districts.

There we have the virtual end of the grandiose scheme by which Germany had, on the admissions of its writers, hoped and expected to be able to attack and devastate our cities with impunity, even to sink our Fleet, and certainly to create a feeling of such terror and helplessness as would compel our Government to accept peace on German terms. It seems ridiculous, in view of the complete exposure of incapacity displayed, that such high hopes could have been entertained by experienced military experts, but there is no doubt that it was the case, and the fact only goes to show how very much over-rated the German war machine was by its authors.

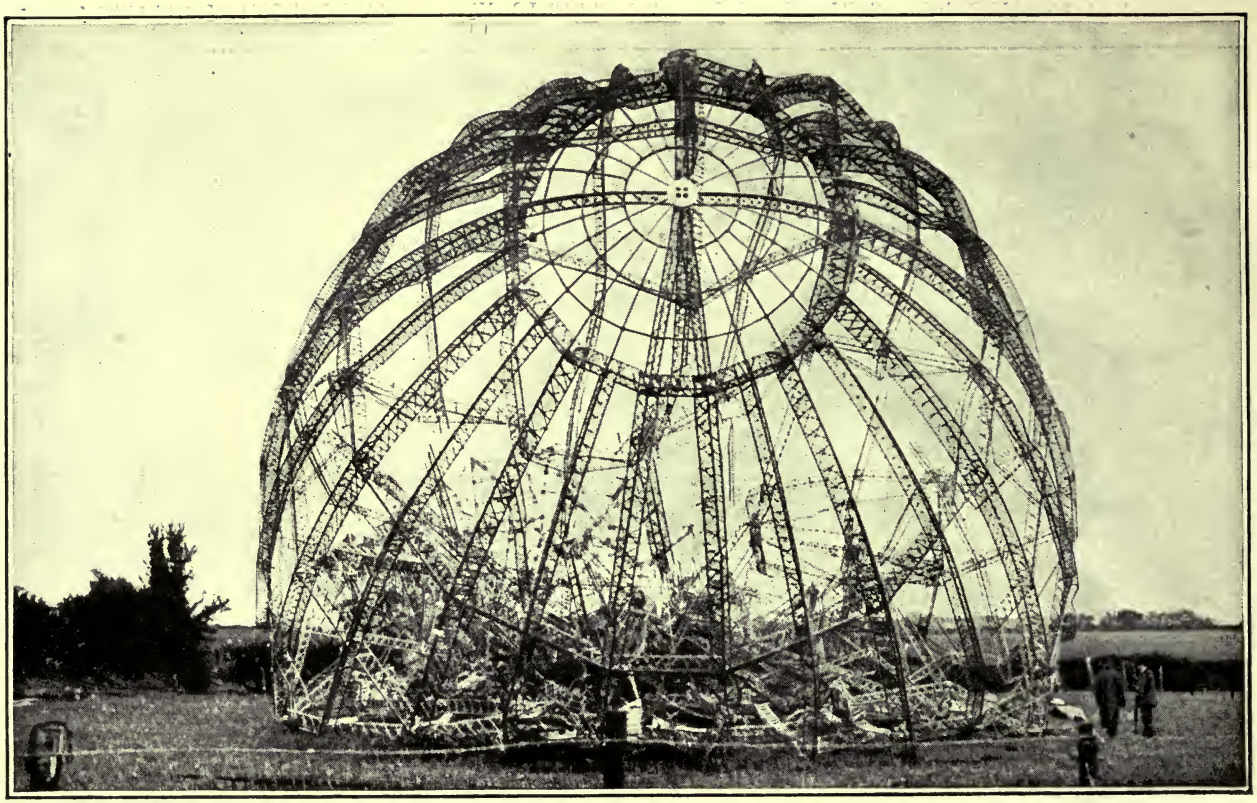
V

WHATEVER may be our opinion of the military value of the Zeppelin, there can be no doubt that, as an engineering creation, it ranks among the most successful products of the twentieth century, and is a monument to

the ability and pertinacity of its inventor. Compelled by the nature of his design to adopt huge proportions of space and the flimsiest of materials, Count Zeppelin yet succeeded in evolving a craft larger than any but the greatest transatlantic steamships; whose total weight is under fifty tons; whose speed in still air is as fast as our fastest express trains, with a radius of operation of five hundred miles at least; and which can be navigated in daylight as certainly as an ocean liner. So high is his achievement that it evokes regret that it should be tarnished by an acquiescence in its use for an unworthy and uncivilized form of warfare.

The framework of the gas container of Zeppelin L33—the first specimen we secured in sufficiently undamaged condition to make a mechanical analysis possible, although the French have since secured L49—was approximately 220 metres or 670 feet long, and 72 feet in diameter at its greatest girth. It was composed of twenty-five longitudinal girders of riveted aluminium lattice-work tapered fore and aft until they converged in the first and last of the twenty-four ring girders which, equally spaced and laced into the longitudinals, composed the frame. The aluminium alloy employed is actually lighter than pure aluminium and is probably magnalium, or a variant of it, in which magnesium is a constituent.

The lattice girders are triangular in plan, the main ribs being channelled and the cross-ties corrugated to secure stiffness. After the fifth ring girder forward each alternate ring is "king-posted"—that is to say, the flat sides of the ring—there are twenty-five flats in each circle—are the bases of small supported triangles of lattice-work with the apices inside the gas container. These "king-posted" girders are tautened inwardly by means of wire stays connecting the junctions between the ring and longitudinal girders with a central hub after the manner of a bicycle wheel, this hub providing a means of tensioning the wire stays so that an equal stress is put on each of the joints of the frame. Through these hubs, fore



Bow of Zeppelin L32

[*Facing p.* 36

ZEPPELIN L31, DESTROYED BY LIEUTENANT SOWREY AT POTTERS BAR, OCTOBER 1, 1916

[*Facing p.* 37

and aft, runs an adjustable wire cable which ends in the nose and tail plates of the frame, so that by it and by the radial wire-stays the whole frame can be tautened or braced and thus greatly stiffened.

The gas envelope consists of two skins. The outer encloses all the framework and is made of a special linen or cotton fabric doped to render it gas-tight and to reduce the air friction on its outer surface. The inner envelope, also gas-tight, has all the framework on its outside so that there is a space between the two skins, into which it is said that the exhaust gases from the engines are forced—a device which, if correct, is intended to fulfil two purposes. These gases, being inert, are non-inflammable and tend to some extent to neutralize any leakage of hydrogen from the gas bags proper—which in the past is said to have caused catastrophe; also the exhaust gases, being hot, can be used to counteract the effect of low external temperatures which cause a loss of bulk and buoyancy.

The two million cubic feet of hydrogen gas required to float the Zeppelin is contained in from eighteen to twenty-four separate ballonets, each provided with a pair of stuffing-box glands to permit the central hawser to pass through without entailing gas leakage. Through the greatest diameter of the gas container is a tunnel leading from the main gondola to the upper surface of the container, where a machine-gun platform is situated, carrying two Maxims. The extreme ends do not contain any gas bag, the fore end being specially braced to resist the pressure due to air resistance when the Zeppelin is travelling, while the rear, tapering away to a point, contains the elevator and rudder plane posts and a machine-gun platform, the final section of the frame here having but six sides.

Along the whole length of the frame underneath runs a cat-walk or footway consisting of wood—the only rigid part of the machine not composed of aluminium. This gives access to the fore and aft sections, to all the gondolas, and to the machine-gun platform at the tail.

There are four gondolas or cars, carrying, in addition

to the crew, six sets of six-cylinder petrol engines driving six air-screws. The engines are rated at 240 h.p. running at about 1,000 revolutions per minute. Two of the gondolas are set along the central line, one forward and the other aft. The forward one carries a single set of engines driving an air-screw behind; the rear one, which is about 40 feet long, is the main car of the Zeppelin and carries three sets of engines, one operating an air-screw behind it, the other two each driving through bevel gearing an air-screw set out from and attached to the frame of the gas container. The engines are of the water-jacketed type with special provision for cooling the lubricating oil as well as the water. Each engine is provided with a clutch, the air-screws being used for manœuvring purposes in addition to propulsion. The petrol tanks are carried in the container frame over the engines, so that they are well away from the engines, and at the same time provide fuel feed which is constant, no matter at what angle the airship may be rising or descending. The other two gondolas are small and attached to one of the longitudinal girders on either side of the container. All are fully enclosed and are warmed by the exhaust from the engines.

All the control operations, including the bomb dropping, are conducted from the forward car, so that the commander is the practical executant of every offensive act. The bombs, sixty in number, are carried about mid-ships in a special hopper in the gas container. Each is released separately by an electric switch in the forward car. The crew may consist of from sixteen to twenty-two, the latter being the full complement, but often supernumaries are carried for instruction purposes. The carrying power, in addition to three tons of fuel for a journey to England and back, is about three tons, and as there is a constant, if slight, loss of buoyancy owing to gas leakage, the return journey is only made possible by the consumption of fuel and the discharge of the bombs carried on the outward journey.

Conclusions arrived at on evidence possibly not yet complete are likely to be confuted, but we believe that there is no physical point left in the Zeppelin problem that has not been exploited to its farthest for the purposes of this war, and, while it may be that future discoveries in science and developments in engineering may give the rigid airship a fresh and more formidable character as a military device, for the time being its limitations have been laid bare and its value has been accurately estimated. As a punitive instrument and as a means of attacking an enemy possessed of proper means and methods of defence, that value is small. But it is easy to imagine conditions in which it would prove a valuable and possibly even a decisive weapon.

Those conditions, however, are not such as to preclude the use of aeroplanes for a similar purpose, and as to the relative values of the two machines for almost every purpose of war there can be no dispute. The aeroplane is immensely superior in every way, and on the evidence of accomplished facts it is fair to assert that there is little that the rigid airship can achieve in war that the big aeroplane cannot be designed to accomplish more certainly, more quickly, and more cheaply. At the moment, however, it is probable that the Zeppelin possesses a distinct and important advantage in naval scouting and long-distance reconnaissance.

Under suitable conditions its value as a high-seas patrol is considerably greater than that of any existing seaplane, not merely because it can travel greater distances from its base and remain a longer time in the air, but because its wireless telegraphic installation, being more powerful than any fitted to an aeroplane, can maintain uninterrupted communication with its base or its fleet and can direct operations from a distance at present far beyond the radius of any other aircraft.

The clearest instance of that advantage was in the Jutland battle when the main German fleet under Von Scheer was so accurately informed of the approach of

Jellicoe's forces that it was able to break off its action with Beatty's battle cruisers in time to escape the annihilation that assuredly would have overtaken it had the action been prolonged sufficiently to permit the whole British fleet to join issue. And throughout the entire course of the North Sea operations of the past thirty-three months it would not be easy to overestimate the scouting and reconnaissance value of the Zeppelin to the German naval plan. Probably before the war is over that value will be discounted by seaplane developments, but it would be idle to deny that as a means of naval observation and direction the Zeppelin has been worth all its heavy expense to the enemy.

As compared with the aeroplane, however, it is a fair-weather craft. Not only is it much more difficult to navigate in heavy weather—the great attack on England in October, 1917, was rendered disastrous by the sudden interposition of a gale which entirely precluded driving directly homewards—but it cannot be launched with safety in the presence of winds of any violence since its huge bulk, fragile construction and great buoyancy render it uncontrollable from the ground in other than calm weather. Moreover its base must be on *terra firma*, whereas the seaplane is almost certain in the near future, if not already, to be able to make the deck of a light cruiser all-sufficient for every purpose of this kind, launching and returning being almost as facile and certain as from the floor of an aerodrome.

Even its load-carrying capacity is being challenged by the big long-distance bombing type of aeroplane, whose greater margin of safety, higher speed, better manœuvring power and lesser vulnerability must in the end do much to write off the airship as a military war-machine. One great advantage of the airship has not been utilized by the enemy to any conspicuous degree—its capacity to travel in absolute silence by taking advantage of a favouring wind to reach its objective.

Many people have wondered that a means of damping

down the noise of the engine-exhaust, such as has been developed with conspicuous success in the motor car, has not been adopted in the Zeppelin. The usual explanation is that the absorption of power inevitable in any such device attached to the powerful engines of an airship would be so great that dirigibility could not be maintained except in the lightest winds. But it is nearer actual fact to point out that, while silence in this way would render approach safe, once the defensive searchlights located the airship, so great are the speed and climbing powers of our newer types of aeroplanes, the ability to use silence for escape would not avail anything, for within a few minutes the aeroplanes would be between it and safety, and cutting out the silencing mechanism and exhausting direct into the air would not afford it any distinct chance of escape.

The really silent Zeppelin able to develop even 75 per cent. of its engine power would be a distinct advance on the present type and under certain conditions would be almost as difficult to frustrate as a submarine, for we cannot conceive human vigilance so tireless and comprehensive as to discover the approach of an airship emitting no sound and travelling by night. But it has not yet appeared and, as we have pointed out, the problem of escape, which is almost as important as that of attack, is not helped by silence to a material degree.

APPENDIX

THE following is a complete list of the Zeppelins known or reported in the Press to have been lost or destroyed since the opening of hostilities. There may have been others, so that this can be considered in the light of a minimum loss.

1914—EIGHT AIRSHIPS.

Aug.	23	Brought down by French guns at Badonviller.
,,	24	Wrecked by storm near Metz.
,,	29	Brought down by Russian guns near Mlava.
Sept.	26	Brought down by Russian guns near Warsaw.
Oct.	8	Destroyed by British naval pilots at Düsseldorf.
,,	14	Brought down by Russian guns at Warsaw.
Nov.	21	Destroyed by British pilots in their sheds at Friedrichshafen.
Dec.	30	Destroyed by British naval airmen at Cuxhaven.

1915—FIFTEEN AIRSHIPS.

Feb.	9	Lost in North Sea.
,,	17	Lost in North Sea off Jutland (2 ships).
Mar.	2	Wrecked at Cologne.
,,	8	Wrecked in English Channel.
,,	8	Brought down by Belgian guns at Antwerp.
,,	12	Wrecked by storm in Belgium.
May	28	Lost in storm in the Baltic.
June	7	Destroyed by Lieut. Warneford at Ghent.
,,	30	Burned near Brussels.
Aug.	3	Brought down by Russian guns near Vilna.
,,	10	Brought down by naval guns off Ostend.
Sept.	9	Burned in mid-air, Belgium.
Oct.	2	Blown up at Kiel.
Nov.	13	Brought down by Russian guns near Grodno.

1916—Twelve Airships.

Feb.	2	L19 sunk in North Sea.
„	21	LZ77 brought down by French gunfire near Revigny.
Mar.	31	L15 hit by British guns and sunk in Thames Estuary.
May	3	L20 wrecked in North Sea off Stavanger.
„	4	Destroyed by British naval gunfire in North Sea.
„	5	Destroyed by Allied guns at Salonika.
Sept.	2	Schütte-Lanz destroyed by Lieut. Leefe Robinson at Cuffley.
„	24	L33 destroyed by British guns in Essex.
„	24	L32 brought down in Essex.
Oct.	1	L31 destroyed by Lieut. Sowrey at Potters Bar.
Nov.	27	Destroyed by British pilots off Coast of Durham.
„	28	Destroyed by British naval gunfire in North Sea.

1917—Thirteen Airships.

Jan.	9	Destroyed by workmen's *sabotage* at Kiel (2 ships).
Feb.	26	Burned in shed at Ghent.
Mar.	17	Destroyed near Compiègne by French gunners.
Apr.	23	Wrecked near Duisburg.
May	14	L22 destroyed by naval forces in North Sea.
June	14	L43 destroyed by naval forces in North Sea.
June	16	L48 brought down by guns in Suffolk.
Aug.	21	Destroyed by naval forces in North Sea.
Oct.	20	Destroyed by French artillerists and airmen (4 ships).

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